

WHAT IS CLAIMED IS:

1. A telescopic shaft for steering of a vehicle, assembled in a steering shaft and including a male shaft and a female shaft that are so fitted as not to 5 be rotatable but to be slidable,

characterized in that a rolling member is fitted through an elastic body for pre-load between at least a pair of axially-extending grooves formed in an outer peripheral surface of said male shaft and in an 10 inner peripheral surface of said female shaft,

15 a slide member is fitted in between at least another pair of axially-extending grooves formed in the outer peripheral surface of said male shaft and in the inner peripheral surface of said female shaft,

and

when a steering torque is equal to or smaller than a predetermined level, said elastic body for the pre-load exhibits a low rigidity characteristic as said elastic body performs pre-load action; when the 20 steering torque is equal to or larger than the predetermined level, said slide member exhibits a high rigidity characteristic as said slide member engages with said pair of axially extending grooves; and two-staged torsional rigidity characteristics of 25 the low rigidity characteristic and the high rigidity characteristic, are thereby provided.

2. A telescopic shaft for steering of a vehicle according to claim 1, wherein said elastic body for the pre-load is constructed of one piece of leaf spring.

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3. A telescopic shaft for steering of a vehicle according to claim 1, wherein said elastic body for the pre-load is constructed of a composite body formed of different materials.

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4. A telescopic shaft for steering of a vehicle with a Cardan shaft joint, to be assembled in a steering shaft, including a male shaft and a female shaft that are so fitted as not to be rotatable but 15 to be slid able, and receiving a connection of a yoke of a Cardan shaft joint,

characterized in that rolling members are fitted through an elastic body for pre-load between at least a pair of axially-extending grooves formed in an 20 outer peripheral surface of said male shaft and in an inner peripheral surface of said female shaft,

a slide member is fitted in between at least another pair of axially-extending grooves formed in the outer peripheral surface of said male shaft and 25 in the inner peripheral surface of said female shaft,

a buffer member is interposed between said yoke and any one of said male shaft and said female shaft,

said yoke is formed with an engaged portion, and any one of said male shaft and said female shaft is provided with an engaging member capable of engaging with and disengaging from said engaged portion, and

5           when a steering torque is equal to or smaller than a predetermined level, said engaging member does not engage with said engaged portion while said buffer member exhibits a low rigidity characteristic as said buffer member performs buffer action; when  
10          the steering torque falls within a predetermined intermediate range, said elastic body for the pre-load exhibits an intermediate rigidity characteristic as said elastic body performs pre-load action; when the steering torque is equal to or larger than the  
15          predetermined level, said engaging member engages with said engaged portion while said slide member exhibits a high rigidity characteristic as said slide member engages with said pair of axially-extending grooves in a peripheral direction; and three-staged  
20          torsional rigidity characteristics of the low rigidity characteristic, the intermediate rigidity characteristic and the high rigidity characteristic, are thereby provided.

25           5. A telescopic shaft for steering of a vehicle, assembled in a steering shaft and including a male shaft and a female shaft that are so fitted as not to

be rotatable but to be slid able,

characterized in that a first torque transfer member is interposed through an elastic body for pre-load between at least a pair of axially-extending 5 grooves formed in an outer peripheral surface of said male shaft and in an inner peripheral surface of said female shaft,

10 a second torque transfer member is interposed between at least another pair of axially-extending grooves formed in the outer peripheral surface of said male shaft and in the inner peripheral surface of said female shaft, and

15 when a steering torque is equal to or smaller than a predetermined level, said elastic body for the pre-load exhibits a low rigidity characteristic as said elastic body performs pre-load action; when the steering torque is equal to or larger than the predetermined level, said second torque member exhibits a high rigidity characteristic as said 20 second torque transfer member engages with said pair of axially extending grooves; and two-staged torsional rigidity characteristics of the low rigidity characteristic and the high rigidity characteristic, are thereby provided.

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6. A telescopic shaft for steering of a vehicle, assembled in a steering shaft and including a male

shaft and a female shaft that are so fitted as not to be rotatable but to be slidable,

characterized in that a first torque transfer member is interposed through an elastic body in at 5 least one line of axially-extending groove formed in each of an outer peripheral surface of said male shaft and an inner peripheral surface of said female shaft,

10 a second torque transfer member is interposed between at least another line of axially-extending groove formed in each of the outer peripheral surface of said male shaft and the inner peripheral surface of said female shaft, and

15 said elastic body includes:  
a transfer member sided contact portion being in contact with said first torque transfer member;

a groove surface sided contact portion spaced at a predetermined interval substantially in a peripheral direction from said transfer member sided contact portion, and being in contact with a groove surface of said axially-extending groove of said male shaft or said female shaft; and

20 25 a biasing portion elastically biasing said transfer member sided contact portion and said groove surface sided contact portion in such a direction as to get separated from each other.

7. A telescopic shaft for steering of a vehicle according to claim 6, wherein said first torque transfer member includes rolling members that roll when said two shafts make relative movements in the 5 axial direction, and

said second torque transfer member includes a slide member that slides when said two shafts make the relative movements in the axial direction.

10 8. A telescopic shaft for steering of a vehicle according to claim 6 or 7, wherein said biasing portion of said elastic body takes a bent shape bent between said transfer member sided contact portion and said groove surface sided contact portion.

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9. A telescopic shaft for steering of a vehicle according to claim 6 or 7, wherein said axially-extending groove of said male shaft or said female shaft has a flat side surface which is in contact 20 with said groove surface sided contact portion of said elastic body, and a bottom surface contiguous to said flat side surface,

said elastic body has a bottom portion facing said bottom surface of said axially-extending groove, 25 and

said bottom portion of said elastic body is set in a contact state with said bottom surface of said

axially-extending groove, or an interval between said bottom surface of said axially-extending groove and said bottom portion of said elastic body is set to a predetermined interval.

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10. A telescopic shaft for steering of a vehicle according to claim 6 or 7, wherein said biasing portion of said elastic body is a separate portion from said transfer member sided contact portion and 10 from said groove surface sided contact portion, and is formed of a different material.

15. A telescopic shaft for steering of a vehicle according to claim 6 or 7, wherein said elastic body includes, in addition to said transfer member sided contact portion, said groove surface sided contact portion and said biasing portion, a second biasing portion formed of a different material as a separate portion.

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20. A telescopic shaft for steering of a vehicle according to claim 6 or 7, wherein said elastic body is constructed of a leaf spring.

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25. A telescopic shaft for steering of a vehicle according to claim 6 or 7, wherein said biasing portion provided as the separate portion and formed

of the different material and said second biasing portion provided as the separate portion and formed of the different material, are made of a rubber or a synthetic resin.

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14. A telescopic shaft for steering of a vehicle according to claim 6, wherein a lubricating agent is applied between said axially-extending groove of said male shaft, said axially-extending groove of said 10 female shaft, said elastic body and said first torque transfer member.